

# PROGRAM facts

U.S. DEPARTMENT OF ENERGY  
NATIONAL ENERGY TECHNOLOGY LABORATORY

## Fuels and Energy Efficiency

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## ULTRA-CLEAN FUELS

### *FY2002 Expanded Activity*

The U.S. Department of Energy's (DOE) Office of Fossil Energy (FE) has developed a Clean Liquid Fuels Program whose overall goal is to promote the development and deployment of technologies that will produce clean, high performance fuels from a variety of secure energy resources. The program addresses key technical and policy issues that span the production, processing, delivery, and end-use of these fuels. The Clean Liquid Fuels Program has five major elements: Exploration, Production and Transport of Petroleum Crude; Petroleum Environmental Solutions; Ultra-Clean Fuels; Future Fuels; and Infrastructure Reliability and Product Integrity.

The Ultra-Clean Fuels program element discussed below contains both an activity with an existing budget and a proposed Expanded Activity for FY2002. The new funding component will enable an expansion of the existing program from ground-based systems alone, to aviation and marine applications; from civilian applications alone to dual-use civilian and military applications, from an emphasis on fuels alone to fuel additives and engine lubricants; and from an emphasis on sulfur removal alone to an expanded suite of criteria pollutants. These additional funds will permit the creation of a comprehensive data base to be developed in order that future environmental regulations may be based upon sound science and be acceptable to both our auto/engine and fuel production industries.

### Background

The U.S. currently imports 56 percent of its petroleum, and imports are projected to increase to over 65 percent by 2020. Domestic oil production continues to decline and crude oil quality continues to deteriorate. Worldwide, conventional petroleum production is expected to peak and then irreversibly decline sometime during this century. The U.S. transportation sector (that accounts for 2/3's of all petroleum use) is responsible for 80 percent of carbon monoxide emissions, one half of the nitrogen oxides, and 40 percent of the volatile organic compounds (VOC) emitted into our air. Further, transportation is responsible for one third of total manmade carbon dioxide [a greenhouse gas] emissions.

Because of these National energy security, public health, and environmental requirements, it is appropriate for government to assist the private sector in promoting the development of technologies that will provide this Nation with a stable supply of ultra clean and affordable energy to fuel our economy in the 21st century.



## Benefits

This program element will promote the development and deployment of a suite of liquid fuels, lubricants and additives that will:

- be usable in a wide range of engine designs, transportation systems (including hybrids and fuel cell vehicles) and stationary applications;
- be compatible with the existing liquid fuels infrastructure;
- allow new and existing vehicle systems to meet more stringent future emissions standards while lowering carbon dioxide emissions from the transportation sector;
- be obtainable from petroleum and non-petroleum resources;
- satisfy ground, aviation and marine, civilian and military needs;
- be cost competitive with future world oil prices and maintain the leadership and competitive position of the U.S. energy industry.

# ULTRA-CLEAN FUELS

## *FY2002 Expanded Activity*

Auto manufacturers and petroleum refiners recognize that success in obtaining high efficiency and ultra-low emissions in transportation can only be achieved by simultaneous improvements in fuel characteristics, engine design, and exhaust emission controls. The emphasis of this program element is “ultra-clean fuels from a full suite of secure fossil energy resources”, however advanced engine design and emission controls are integral parts of the overall DOE strategy. Fuel characteristics and subsequent combustion behavior are vital to the proper functioning of the vehicle-engine-emission control system if simultaneous low emissions and high efficiencies are to be achieved. The successful implementation of this program will help provide the Nation with a balanced portfolio of energy options that is stable, secure, and affordable with minimal impact on the environment. A final critical criterion of this program element is that these fuels be able to utilize the Nation’s existing liquid fuels infrastructure.

## Description

The program is divided into two main technology areas: Advanced Refinery Processes and Advanced Synthesis Gas Processes.

In the Advanced Refinery Processes area, major issues are the production of significant additional hydrogen needed for gasoline and diesel hydrotreating to meet EPA Tier 2 regulations, the phase-out of MTBE that will result in the need for alternate oxygenates, the projected shortfalls in octane for gasoline and cetane for diesel, and the continuing decline in crude oil quality. These issues are driving the need to develop advanced technologies to produce ultra-clean fuels from conventional petroleum, heavy oils and bituminous feedstocks and, processes to convert crude oil residua and coke. Advanced refinery processes include upgrading of naphtha, distillate, and gas oil to produce ultra-low sulfur, high octane, high cetane products and processing of petroleum residues by advanced hydrocracking, hydroprocessing, or coking.

In the Advanced Synthesis Gas Processes area, certain key technology demonstrations must be undertaken to establish an acceptable level of risk for future commercial ventures that will use low-cost feedstocks such as stranded and flared natural gas, petroleum coke and coal. Syngas production from coal and natural gas and its subsequent conversion to liquid fuels are capital intensive, so technologies that can significantly reduce these costs are vital to the success of this program. Advanced syngas processes include production from petroleum residuals and wastes, coal, and other carbonaceous feeds via advanced gasification, and natural gas, partial oxidation/reforming. Clean syngas is then converted into hydrocarbons or oxygenates. Products are then further processed to produce ultra-clean fuels that can be used neat or blended with petroleum-derived fuels to achieve lower emissions.

**Different U.S. Gasoline Requirements as of June 2000**  
*Source: Exxon-Mobil*

